anatomy, eighty-seven original researches appeared during this period; in physiology, a hundred and fifty-two. The number of special investigations in botanical geography during the last twenty years amounts to twenty, while the articles relating to local floras number about a hundred.

During this period, zoölogy developed in two directions: on the one hand, investigations of faunas, increasing considerably in quantity and quality, form a continuation of the preceding period; and, on the other hand, a new phase of zoölogical research is inaugurated by workers in the field of comparative anatomy, of animal histology, and of embryology. At the head of this last movement, fortunately, we find such exceedingly talented men and energetic workers as Kovalèfsky and Mèchnikoff, who enjoy in Europe a reputation not less honorable than that of the principal representatives of our chemical school. This is the reason why the new movement not only soon extended over Russia generally, but gained a strong foothold; so that at present it has representatives in every university, and unites the body of common workers into a Russian zoölogical school.

A review of the development of mineralogy and geology in the universities during the last twenty-five years is embarrassed with two difficulties. In three of the six universities to which this article refers, the scientific workers of the previous epoch continue their activity into the present period. On the other hand, the mining-engineers, *pari passu* with the university-workers, begin to work zealously, and their common labors appear in the same publications. An over-nice discrimination of the work of the mining-engineers from the work done by the universities, will, however, be superfluous, when we reflect that the stimulation of scientific activity among the mining-engineers is primarily due to the same causes that infused new life into the universities themselves. These causes were the reforms in the mining-corps (now become a mining-institution) which were in the same direction as the new system of instruction in the natural science faculties. The increased activity among the mining-engineers, being a product of the same cause, merely fortifies by additional proof the leading idea of this article. From this point of view, the activity in mineralogy and geology will appear to have increased very considerably. Since 1869 the St. Petersburg mineralogical society has published thirteen volumes of 'Materials for the geology of Russia' (in Russian). In the St. Petersburg society of naturalists alone, there were received two hundred and ten original communications from 1868 to 1882 inclusive; and, in the 'Index to Russian literature in mathematics and pure and applied science' (in Russian), we find enumerated two hundred and seventy-four works (pamphlets and books) on mineralogy and geology for the period 1873 to 1879. In addition, it should be mentioned that our present university geologists, by practical work, have transplanted to Russian soil the problem of prehistoric man, and the application of microscopy to the investigation of mineral species.

Finally, as above mentioned, the sciences of microscopic anatomy and physiology began to be cultivated in Russia between 1860 and 1870. The first to introduce them were the Dorpat professors, the late Yakubòvich and Ovsiànnikoff. They were followed by a succession of Russian specialists who had studied abroad between 1855 and 1865. The following data will show to what extent these young sciences took root and thrived in Russia. When in Germany, between 1870 and 1880, the composition of histological and physiological text-books was undertaken by collaboration, our scientific men, being recognized as specialists, were asked to write certain parts of these works. Some of them complied with this request; as, for instance, Babùkhin and the late Ivànoff. There are even names to which the honor belongs of having established new and important methods of research: to Khronshchèfsky, for instance, is due the method of transfusion. At the present day, there is hardly a branch of these two sciences that has not been more or less successfully attacked by Russian investigators; and a large proportion of their work has been done at home.

Such is a general outline of the results obtained by our universities in natural science, thanks to the reforms introduced in the seventh decade of our century. In reality they are even greater than here represented, since the data at my disposition do not include every thing actually accomplished. Is not this ample evidence that the naturalists of our universities have commendably improved their opportunity, and honorably fulfilled the task imposed on them? Not to speak of the industrial and other material advantages always following the development of natural science in a country, the mere fact that this development exists is of great importance from an intellectual point of view, especially for novices in civilization, like ourselves.

The appearance of science always marks the culminating-point in intellectual development: it is always and everywhere the surest touchstone of the capacity of a race for the highest culture. When a race has successfully undergone this test, it at once takes its place among civilized nations. When recently we mourned Turgièneff, it was justly pointed out as one of his merits, that his work had fostered the intellectual commerce of Russians with the west. Did not our naturalists do the same?

It must, however, be confessed, that, in spite of all this, we are still novices in science, and our young plantations require assiduous care. The experience of twenty-five years has demonstrated that the conditions favorable to development are to be sought in the establishment of laboratories, and in the increase of the staff of instructors. These conditions of progress, therefore, must be extended in the future, as is done in western Europe, or they must at least be maintained.

RECENT LINGUISTIC RESEARCHES.

'TOPONOMASTICS,' or the analysis of geographic names, is a branch of linguistics, which, on account of the large material and numerous publications accu-

mulating on the subject, should be considered a science by itself. Attempts to explain certain topographic appellations are found in some of the earliest writings of antiquity. Linguists and historians of prominence have always paid peculiar attention to this field of research, for no object has been named by early man without causes. Professor Egli of Zürich, who previously composed a voluminous book in furtherance of these studies (Nomina geographica, Leipzig, 1880), has just presented us with a bibliographic history of local onomatology.[1] Egli mentions over four hundred authors who have written, either exclusively or incidentally, on this instructive branch of knowledge, and subdivides their writings into four periods. The first of these extends from the earliest centuries down to 1815; the second, from 1815 to 1840; the third, from 1840 to 1860; and the last one, from 1860 to 1870. In the researches made upon American Indian locality-names, no author is more prominent than J. H. Trumbull. In another article, Egli has discussed the co-operation of Swiss scientific men in furthering local onomatology (1884).

An inquiry into the historic tribe of the Susquehannocks and the origin of the name Susquehanna has been published by Abraham L. Guss in the *Historical register* of Harrisburg, Penn. (and also issued separately), under the title 'Early Indian history on the Susquehanna.' The Virginia map of Capt. John Smith of 1606 is added to the treatise, and is of the highest importance for the early topography of these countries. The author, after a careful examination of the passages which refer to the early settlements on Susquehanna River, takes the ground, that the tribe in question was of the Iroquois stock, but that the name of the river is Algonkin, and has to be rendered by 'brook-stream,' or 'spring-water stream.'

A publication of no little interest, since it refers to an almost unknown language, is that of the Chipewayan-Tinné legend of the serpent-woman, by Emile F. S. Petitot. It is given in the original Chipewayan, with a French translation, by the Paris periodical *Melusine* (vol. ii. no. i., 1884, col. 19–21). The same interesting number also contains all the names of the rainbow of which the author could obtain any knowledge, together with explanations and myths referring to this phenomenon of nature.

Mr. John Menaul, teacher at the Laguna Pueblo of New Mexico, which speaks a Kéra dialect, is busy printing a Laguna-English catechism on his missionary press. Mrs. A. E. W. Robertson has just published her translation of the two epistles of St. Paul to the Corinthians into Creek, or Maskoki, through the American Bible society of New York (1883). Prior to this, she had translated almost the whole New Testament, with the help of instructed natives.

Ten articles previously made public by the Americanist, Count Hyacinth de Charencey, have been gathered by him in a reprint entitled 'Mélanges de philologie et de paléographie américaines' (Paris, *Leroux*, 1883. 195 p. 8°). They all refer to Mexican and Central-American languages, or to the decipherment of the calculiform Maya characters, the signification of which is still a riddle. The more noteworthy of the purely linguistic articles are those on the Sonorian group (called by him, curiously enough, the Chichimec family); on the Chiapanec, Tzotzil, Tzendal, and Cakgi; on the phonetic laws observed in the Maya family, which is called by him Mam-Huaxtec family in this article, but afterwards Maya-Quiché. Count de Charencey is one of the most active living investigators of the Indian languages, and deserves great credit for the ingenious manner by which he is prompting his countrymen to pursue these studies. But the whole attention of Europe being now directed towards the new discoveries in Africa and in parts of Asia, it seems that the time has not come yet for a general revival of Americanistic studies in Europe.

The study of jargons, or mixed languages, is a specialty to which Professor Hugo Schuchardt, the Romanist, has been devoting himself for many years. His results are published from time to time in the Proceedings of the philosophic-historic section of the Vienna academy of sciences. Three of the latest are on the Malayo-Spanish jargon of the Philippine Islands, on the English of Melanesia, and on the Indo-Portuguese of Mangalore. Schuchardt's series is published under the heading 'Kreolische studien,' and contains a large number of native songs, and other instructive specimens of the jargons spoken of. Translations are not always added to these pieces, because the majority of linguists can do without them.

A handy manual of Chinese grammar has recently been published in German by Georg von der Gabelentz, professor of oriental languages at Leipzig university.[1] It forms an extract, in succinct form, from the grammar published by the same sinologist two years before. The book is a safe guide through the intricacies of that monosyllabic language, in the acquisition of which, contrary to other languages, the judgment of the learner is put to greater activity than the memory. Twenty pages suffice to impart the elements of Chinese writing; and a short *aperçu* of the literary history of the country is added to the volume. To the Chinese words and quotations is added throughout a transcription into Roman characters.

A short scientific sketch of the Khasia language, spoken in the drainage-basin of the Brahmaputra River, eastern India, is given by A. de la Calle in the *Revue de linguistique* of Paris (1884, pp. 24–40). This article mainly consists of classified extracts from Abel Hovelacque's study of the same language, published three years since in the same periodical. Both show that Khasia holds a middle position between the isolating and the agglutinative languages, and that the majority of its terms are restricted to one syllable only.

The same number of this review concludes a bibliography of Basque folk-lore by Julien Vinson, its

[1] J. J. Egli. Ein beitrag zur geschichte der geographischen namenlehre. Wien, *Hölzel*, 1883. 106 p. 8°. (*Zeitschrift f. wissensch. geographie*, vol. iv.)

[1] Anfangsgründe der chinesischen grammatik mit übungsstücken. Leipzig, *Weigel*, 1883. 8 + 150 p. 8°.

editor. This periodical devotes special attention to the study of the Basque dialects, traditions, and literature.

The tribes of northern and north-western Australia, of which so little is known, have been sketched by Edward Palmer in the *Journal of the anthropological institute*, 1884, pp. 276-334. His article contains statements which evidently come from an experienced traveller. Nine tribes are described as to their physical and social characteristics, cannibalism, food, cooking and hunting, weapons, manufactures, amusements, superstitions, bora-ceremonies, funerals, etc. The chapter on *gentes*, or, as Palmer calls them, class-systems, brings together a large amount of new facts; and the seven vocabularies concluding the paper extend over more than a hundred and sixty terms. A. S. GATSCHET.

MODERN RAIL-MAKING.

THE making of steel rails consists of three distinct processes: the production of cast-iron from the ore; converting the cast-iron into steel in a Bessemer converter, and casting it into ingots; and rolling out the ingots into rails. According to the most recent practice, these operations follow each other so closely as to seem almost one.

Cast-iron is obtained from iron ore by reducing the ore in a blast-furnace with coke for fuel, and limestone as a flux to facilitate the reduction. The blast-furnace consists of an approximately cylindrical iron structure about seventy-five feet high, lined with bricks of refractory material, leaving an internal diameter of about twenty feet. A similarly lined bottom is securely fastened on, but can be removed for repairs. The top is closed by a cone-shaped cover suspended inside of the top of the furnace, which is here reduced in diameter. This cone is held in place by a lever and counter-weight. Air is supplied under pressure by blowing-engines, which are simply large air-compressing pumps, through openings, or tuyères, near the bottom of the furnace. The hot gases of combustion escape through openings near the top of the furnace, and are conducted away by pipes and underground conduits, — part to heat the boilers, which supply steam to the blowing-engines; and part to 'stoves,' to heat the air-blast on its way from the engines to the furnace. These stoves consist of a number of up-and-down passages built in fire-brick. Gas from the furnace is burned in one of them until it is highly heated; then the gas is turned into a cool stove, and the air-blast forced through the hot one.

The iron ore, as received from the mines, is stored in a large yard, each kind of ore occupying a specified place. The coke is stored in a large and high shed, into which it is unloaded from cars run in on overhead railroad-tracks. Supposing the blast-furnace to be in operation, the ore, limestone, and coke are loaded in hand-carts, as required; hoisted on an elevator to the charging-floor, which is on a level with the top of the furnace; and dumped upon the cone cover before mentioned. When the requisite number of loads of each kind of material is deposited on it, the cone is lowered for an instant, and the charge slides over its edge into the furnace. The ore is reduced, forming iron, which sinks by its weight to the bottom of the furnace, and a glassy slag containing most of the impurities, which floats on the top of the iron. The molten iron is drawn off through an opening at the bottom of the furnace, and, flowing through a channel in the sand floor, runs into a cup-shaped ladle holding between five and ten tons. This ladle is mounted on a narrow-gauge car on a track which leads to the converter. This completes the first stage of the process. If the iron drawn from the blast-furnace were run into channels on a sand floor, and allowed to cool, it would be the ordinary form of cast-iron known as pig-iron.

The converter, which is the essential feature of the Bessemer process of making steel, consists of a cylindrical iron casing, on which is placed a tapering portion, connecting it to a nozzle of smaller diameter. This nozzle is inclined at an angle of about forty-five degrees to the cylindrical part. The whole casing encloses a thick lining of highly refractory material. The bottom is double, the upper part being made of material like the lining, and pierced with numerous small holes, through which the air is forced in. The converter is supported on two hollow trunnions, through which the blast is supplied, and led by pipes to the double bottom. We will suppose that the converter has been heated, and is ready for a charge. The ladle of molten iron from the blast-furnace is drawn by a locomotive on an elevated track to a point a few feet above and in line with the converter. The latter is turned on its trunnions until the iron is readily poured into it from the ladle, through the nozzle or mouth. The blast of air is turned on at a pressure increasing to twenty-five pounds per square inch, and the converter turned upright. Rapid combustion takes place, the principal impurities in the iron are first attacked and burned out, the free or uncombined carbon burns next, then the combined carbon begins to leave the iron, and shortly a nearly pure iron is left in the converter. It is now turned as before, and the blast stopped: if continued, the iron itself would be oxidized. This portion of the process usually occupies about ten minutes, although some ores do not require over six, and twenty may be necessary with others.

In the mean time, an iron rich in carbon and manganese, called spiegeleisen, has been melted in a cupola resembling the blast-furnace. A definite quantity, determined by experience and analysis, has been run into a car-ladle; and, as the converter is turned at the end of the 'blow,' this car is drawn out on the track before mentioned, and the spiegeleisen poured into the converter. This is to replace, to a certain extent, the carbon burned out during the blow; the quantity being exactly determined by the quality of steel required, according to the general principle that the more carbon added, the harder is the product. The converter is now turned down; and the molten steel, which may be as much as ten tons, is poured from the nozzle into a ladle. This ladle is mounted on a hydraulic crane which stands